39) The method of claim 36 wherein each free neighborhood comprises a region in ~~which motion of the corresponding edge comprises motion on the boundary~~ of the modeled swept volume.

REMARKS

Telephone Discussion

The undersigned would like to thank the Examiner for the telephone discussion held on August 5, 2002. During this discussion, the Examiner expressed concerns regarding the clarity of the application. The undersigned expressed the opinion that the disclosure is sufficiently clear so as to avoid undue experimentation in implementing what was claimed and also noted that further clarification would be provided by this response. The undersigned noted his confusion regarding what constitutes an “abstract” object as discussed in, for example, Section 10 of the Office Action and requested specific examples. The Examiner noted that he did not have a specific example of an “abstract” object; instead, he responded in general stating that it was not a “real world” object. The Examiner agreed to give more thought to this question so as to provide a more specific example of an “abstract” object. The undersigned expressed concern that he may be unable to fully address the Examiner’s questions regarding “abstract object” unless a specific example can be provided.

Remarks on Office Action

All pending claims (1-15, 17, 18, 21-24) were rejected in an Office Action mailed May 21, 2002. These claims have been canceled and new claims 25-39 added. The undersigned believes that many of the points raised by the Examiner in the Office Action have been rendered moot by these claim amendments. Relevant points are addressed by the undersigned’s remarks, below. The undersigned’s remarks, below, may be preceded by quotations of related comments of the Examiner, presented in small bold-face type.

7. Claims 1-15, 17-18 and 21-24 of the application are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. … the specification appears to have inconsistent descriptions of free neighborhood throughout, thus making the claims indefinite.

The Examiner, in his comments, alleges both (i) a failure to particularly point out and distinctly claim the subject matter and (ii) inconsistent descriptions of free neighborhood throughout the specification. With respect to point (i), the claims of the present application have been amended to clarify the invention being claimed and it is believed that these amendments will fully address the Examiner's concerns. With respect to point (ii), the undersigned believes that the claim amendments and remarks set forth herein will make clear that the specification is consistent with respect to the matter that is claimed. The undersigned notes that the specification includes a simplified swept volume computation wherein the process is disclosed in terms of 2D objects in two dimensions (admittedly, for such implementations, swept "area" may be a better description than swept "volume", however, this distinction is understood to one skilled in the art. The specification also includes disclosure applicable to 3D objects moving in 3D space (a true swept "volume"). The undersigned believes that the appearance of a material inconsistency would only result if the Examiner were to intermix that disclosures related to 2D applications with the disclosures related to 3D implementations. In any case, the language of the claims has been amended to clearly distinguish between the 3D and the 2D implementations and the specification corresponding to the claims as amended is believed to be clear and consistent.

The following sections address specific inconsistencies alleged by the Examiner. In many cases, the particular claim language referenced by the Examiner has been changed by amendment and, consequently, the specifically alleged inconsistency no longer exist. Nevertheless, the alleged inconsistency is discussed where the undersigned believes that such discussion is helpful to prevent any further misunderstanding of the application and claims.

7.2 … Why is the free neighborhood of the vortex [sic - vertex] limited by angular extension of the first and second edges?

Additionally, with respect to Claim 4, in Fig. 5 the free neighborhood of a point is shown by two circular sectors delimited by the extension of the edges of the polygon. Why is it that the free neighborhood does not include all area around the point, outside the polygon? Why is it limited to two circular sectors.

The Examiner's question regarding why the free neighborhood of the vertex is limited by angular extensions of the first and second edges may be better explained with reference to the following figure (to prevent confusion with figures of the specification, this explanatory figure is numbered with the prefix "A"). Fig. A is derived from disclosure found in the filed application figures.

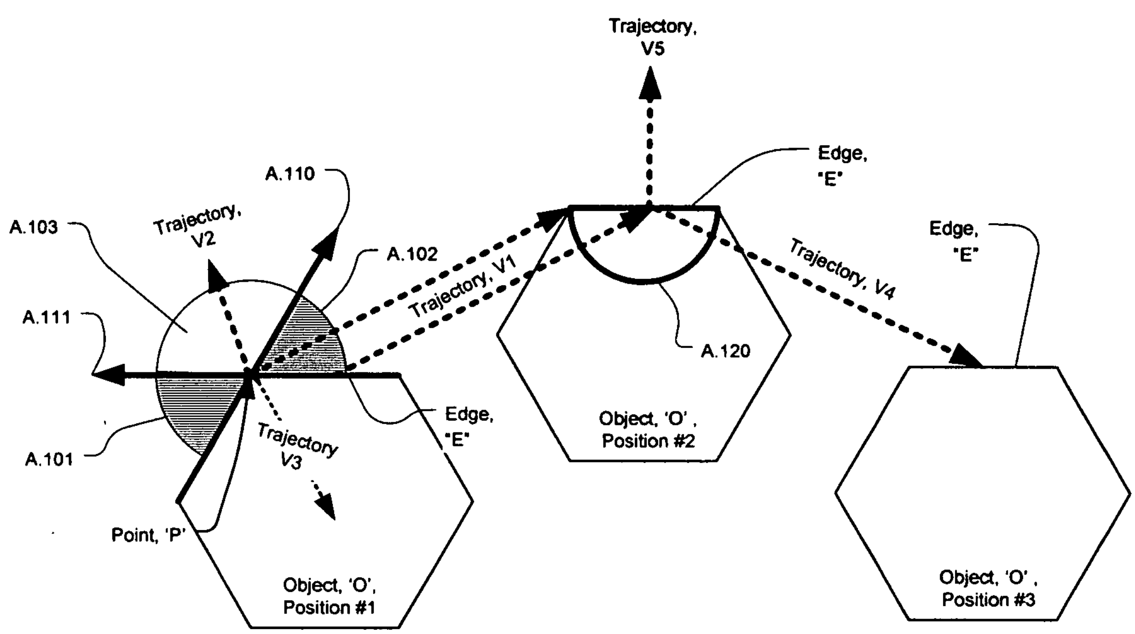

Figure A.1

Figure A.1 shows an object, O, in motion from position #1, to #2, to #3. Although the Examiner's questions are most relevant in a 2D implementation, for additional clarity, the explanation herein will cover both 2D and 3D implementations.

<u>With respect to a 2D implementation:</u>

To compute the boundary of the swept volume (i.e., a swept area) that is formed by the motion of O, the motion of various vertices and edges on O's boundary can be analyzed to determine whether each such entity is also on the boundary of O's swept volume. With regard to point P, as disclosed in the specification, we may determine whether P remains on the boundary of the swept volume during motion from one point to another along a trajectory based on the free neighborhoods of P. Further, as disclosed in the specification, a vertex P has free neighborhoods A.101 and A.102 that are defined by angular extensions A.110 and A.111 of edges. These free neighborhoods can be used to determine whether P remains on the swept volume (i.e., swept area) boundary.

If P (and, correspondingly O) moves in the direction of a vector V1 that extends from P outward through the free neighborhood A.102 (or, similarly, through free neighborhood A.101), then the space that P traverses along that vector will remain on O's boundary (or exterior to O) as O travels along that same vector. However, if the motion of P (and, correspondingly, O), is in the direction of vector V2 (i.e., in a vector direction that is not through a free neighborhood), then what happens is that as O moves in the direction V2, the path traversed by P will not remain on the boundary nor will it remain exterior to the volume traversed by O, but, instead, O will pass over the path traversed by P (i.e., P will become interior to O). Hence, P is not on the swept volume boundary if motion is along a vector V2 that is not through a free neighborhood. Similarly, if the direction if P is along vector V3, then the path of P is through an area previously occupied by O and, hence, that path cannot be on the boundary of the swept volume.

With respect to an edge "E", we are interested in determining if the edge E is on the boundary of the swept area. However, with regard to edges in 2D, what we are interested in is determining is whether the edge is on the boundary at a particular position of the object (i.e., positions 1, 2, 3 in Fig. A), rather than a trace of the edges. (See Fig. 8 of the specification showing edges that are on the boundary at particular positions in bold face). As disclosed in the specification, an edge is on the boundary if its motion is within the material zone during motion of the object to / from the position. So, referring to Fig. A, edge E is on the boundary of the swept volume when object O is at position 2 if the motion of edge E was in the material zone A.120 both as the object O moved from

position 1 to position 2, and as the object O moves from position 2 to position 3. If, on the other hand, the object O were to move from position 2 along trajectory V5, rather than vector V4, that motion would not be through the material zone and, consequently, edge E would not be on the swept volume boundary with respect to the object at position 2 even though motion from position 1 to position 2 was through the material zone A.121.

<u>With respect to a 3D implementation:</u>

Generally speaking, 3D implementation are an extension of the 2D implementations. However, in 3D space, calculations performed on an "edge" are analogous to those performed for a vertex in a 2D implementation. Similarly, in 3D space, calculations performed on a polygon (e.g., triangle) are analogous to those performed on an "edge" in a 2D implementation. Thus, referring to Fig. A, above, consider object 'O' as a 3D object moving in 3D space where point P is a end-view of an edge (i.e., it is the view of an edge that extends into / out of the page). Further, in the 3D case, the "tangent zones" are formed by extending the polygon faces that form the edge seen as P. That is, A.111 and A.112 should be viewed as planes that lie along a third axis extending into / out of the page. Now, as in the 2D case, if P (here representing an edge) moves within the tangent zones A.101 and A.102, then the motion of P is on the swept volume boundary.

With respect to a 3D implementation, edge "E" in Fig. A represents an edge of one of the polygons forming the modeled object O. As described in the application, these polygons are triangles. Thus, edge E is a side-view of a triangle that extends into and out of the page. We are interested in determining if the triangle corresponding to edge E is on the boundary of the swept volume. By extension of the 2D concepts discussed above, with regard to these polygons in 3D, what we are interested in determining is whether the polygon (i.e., the triangle) is on the swept volume boundary at a particular position of the object (i.e., positions 1, 2, 3 in Fig. A). As disclosed in the specification, the triangle is on the boundary at a particular position of the object if its motion is within the material zone during motion of the object to and from that position. So, referring to Fig. A, triangle E (viewed as a 2D edge E) is on the boundary of the swept volume when object O is at position 2 if the motion of edge E was in the material zone A.120, both as the object O

moved from position 1 to position 2, and as the object O moves from position 2 to position 3. If, on the other hand, the object were to move from position 2 along trajectory V5, that motion would not be through the material zone and, consequently, triangle E would not be on the swept volume boundary with respect to the object at position 2.

7.3 ... Does the free neighborhood consist of points or space outside the object or does it include the space or volume inside the object

The free neighborhood may include space outside or inside the object depending on the particular entity type and whether motion is in 2D or 3D. More particularly:

<u>In 2D:</u>

- Free neighborhood of a vertex is a tangent zone exterior to the object.
- Free neighborhood of an edge is a material zone interior to the object.

<u>In 3D:</u>

- Free neighborhood of an edge is a tangent zone exterior to the object.
- Free neighborhood of a polygon, is a material zone extending interior to the object.

Does the sphere mean that free neighborhood is volume and not area?

For models in motion in two-dimensional space, the free neighborhoods are defined by an area. For models in motion in three-dimensional space, the free neighborhoods are defined by volume.

7.7 When will the entities on the boundary of the object not be on the boundary of the swept volume?

Generally speaking, an entity, at a particular position in space, is not positioned along the boundary of the swept volume if motion of the object is such that the object will

occupy that particular position of the entity. This is more fully explained, above, in response to the Examiner's point 7.2.

Rejections under 35 USC § 101.

> **10. Claims 1-15, 17-18 and 21-24 of the application are rejected under 35 U.S.C. 101 because the claimed inventions are directed to non-statutory subject matter. … The computer simulated object could be an abstract object … there is no indication of real world object. What will be the practical application if you are computing the swept volume of an abstract object?**

The claims have been amended to recite "real-world" object as suggested by the Examiner. However, the undersigned is uncertain as to what is meant by an "abstract object." For example, does the Examiner consider an (arguably) conceptual object such as a "black hole" a "real world" object or is it an "abstract object"? The undersigned assumes it is a "real world" object. To be clear, the undersigned believes that a model of any physical object or property (whether proven or conceptual) that is associated with a physical object is "real-world" object. If the Examiner has a more limited view, then a further explanation is requested and it is requested that the Examiner provide a specific example. This is necessary to ensure that the undersigned has not added an unintended limitation.

Rejections under 35 USC § 102(e)).

> **12. claims 1-3, 9-13, 17-18 and 21-22 are rejected under 35 U.S.C. 102 (e) as being clearly anticipated by Xavier (XA).**
>
> **16. Subject to rejections listed above … Claims 4-6, 8, 14-15, and 23-24 do not appear to be taught or rendered obvious, and are indicated as allowable subject matter.**

The claims of the present application been amended to incorporate the substance of the patentable material as set forth in claims 4-6, 8, 14-15, and 23-24. Consequently, all pending claims are believed to be in condition for allowance.

CONCLUSION

Claims 1-15, 17, 18, 21-24 have been canceled and new claims 25-39 have been amended. Claims 25-29 are now pending and believed to be in condition for allowance. Applicant respectfully requests that all pending claims be allowed.

Please apply any credits or excess charges to our deposit account number 50-0521.

Respectfully submitted,

Date: Aug 14, 2002

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